Awake Craniotomies

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Indications

- Biopsies
- Movement disorder procedures
- Speech mapping
  - Tumors
    - Lesions in or around frontal operculum, superior temporal gyrus, angular gyrus
  - Epilepsy surgery

Advantages

- Continuous neurological monitoring
- No complications from intubation
- No issues with emergence (BP, diminished mental status)
- Possibly—shorter ICU stay

Disadvantages

- No immediate control of airway
- Cannot hyperventilate for brain swelling
- Patient stress/agitation

Movement disorder patients

- For functional surgeries such as deep brain stimulators
- First, sedation for frame application
- Secondly, tremor suppression to allow for optimal imaging
- Comfort for drilling, etc. but **without** symptom suppression in the OR
- Need to be alert enough to report visual phenomena and sensory changes

Open craniotomy for tumor

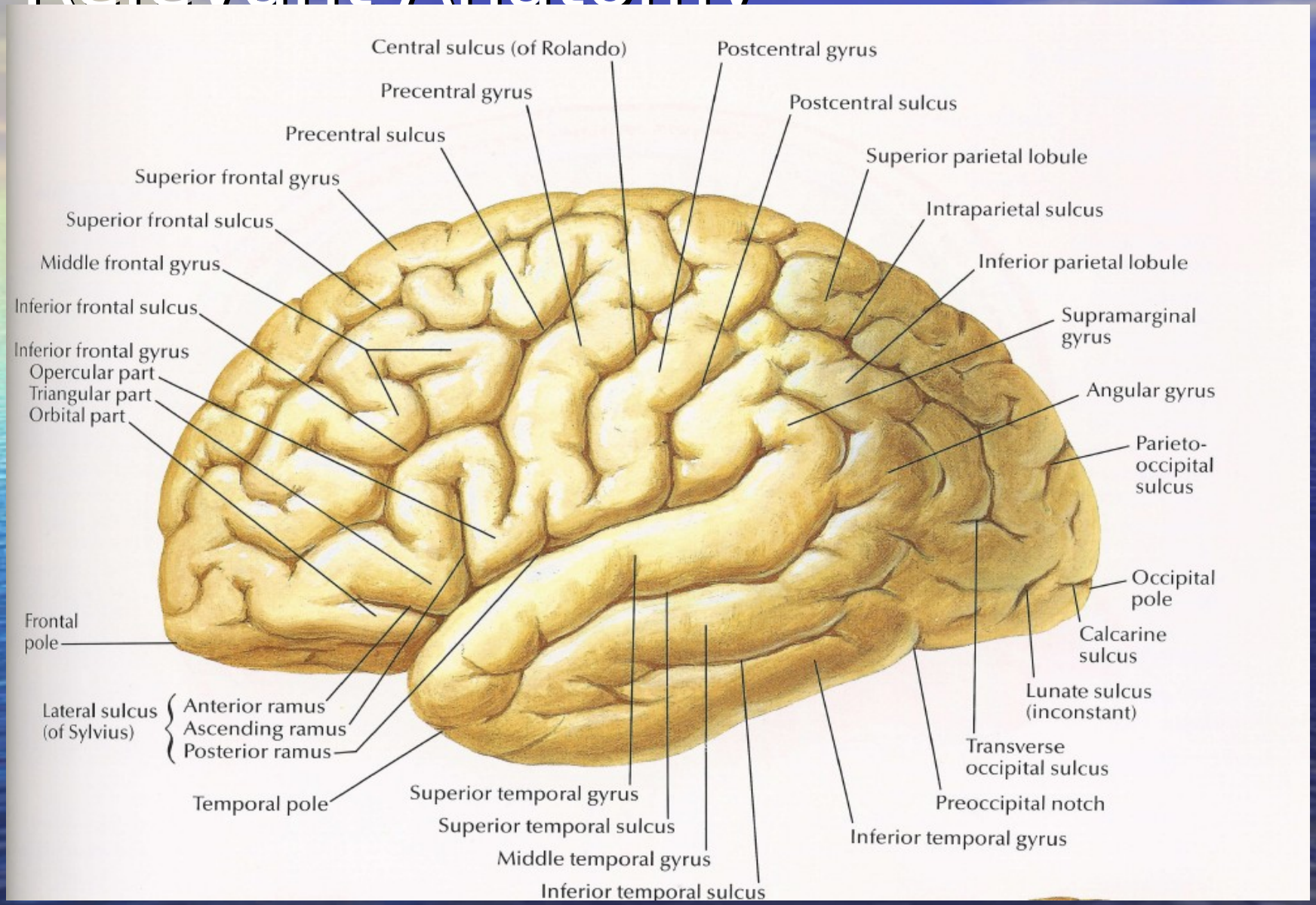
The Team

- Patient
- Neuropsychologist
- Anesthesiologist
- Neuromonitoring technician
- Neurosurgeon
- Neurologist

Keys to Success

- Patient selection
  - Must have the right demeanor
- Patient preparation
  - Pre-op practice with neuropsych testing
  - Thorough description of sequence of events

Relevant Anatomy



Sagittal T1 Weighted MRI

FLAIR-Weighted Axial Image

Surgical Steps

- Positioning
- Scalp and bone flap elevation
- Dural opening
- +/- ECoG
- +/- Neuronavigation (STEALTH)
- Identification of primary motor/sensory cortices
- Mapping with Ojemann stimulator
- Resection
- Closing

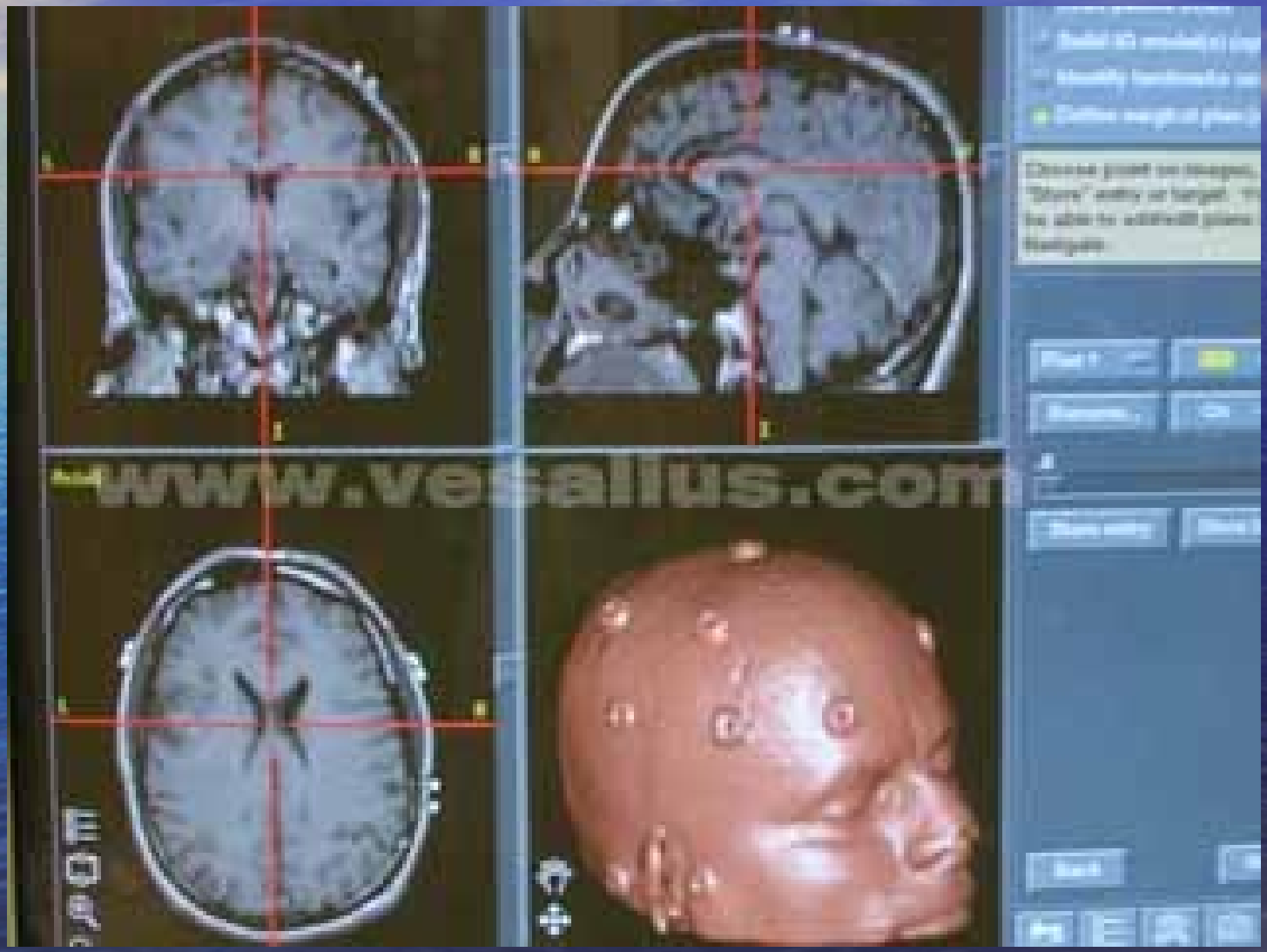
Postioning

- Emphasis on comfortable positioning
- Foley
- Skull pins
- Draping

Scalp, Bone, and Dura

- Extensive peri-incisional and field blocks
  - Mixture of short and long acting agents
  - Target supraorbital, deep temporal, retroauricular, and occipital areas (depending on target)
- Adjuncts to dural opening—local anesthesia to dura near middle meningeal artery

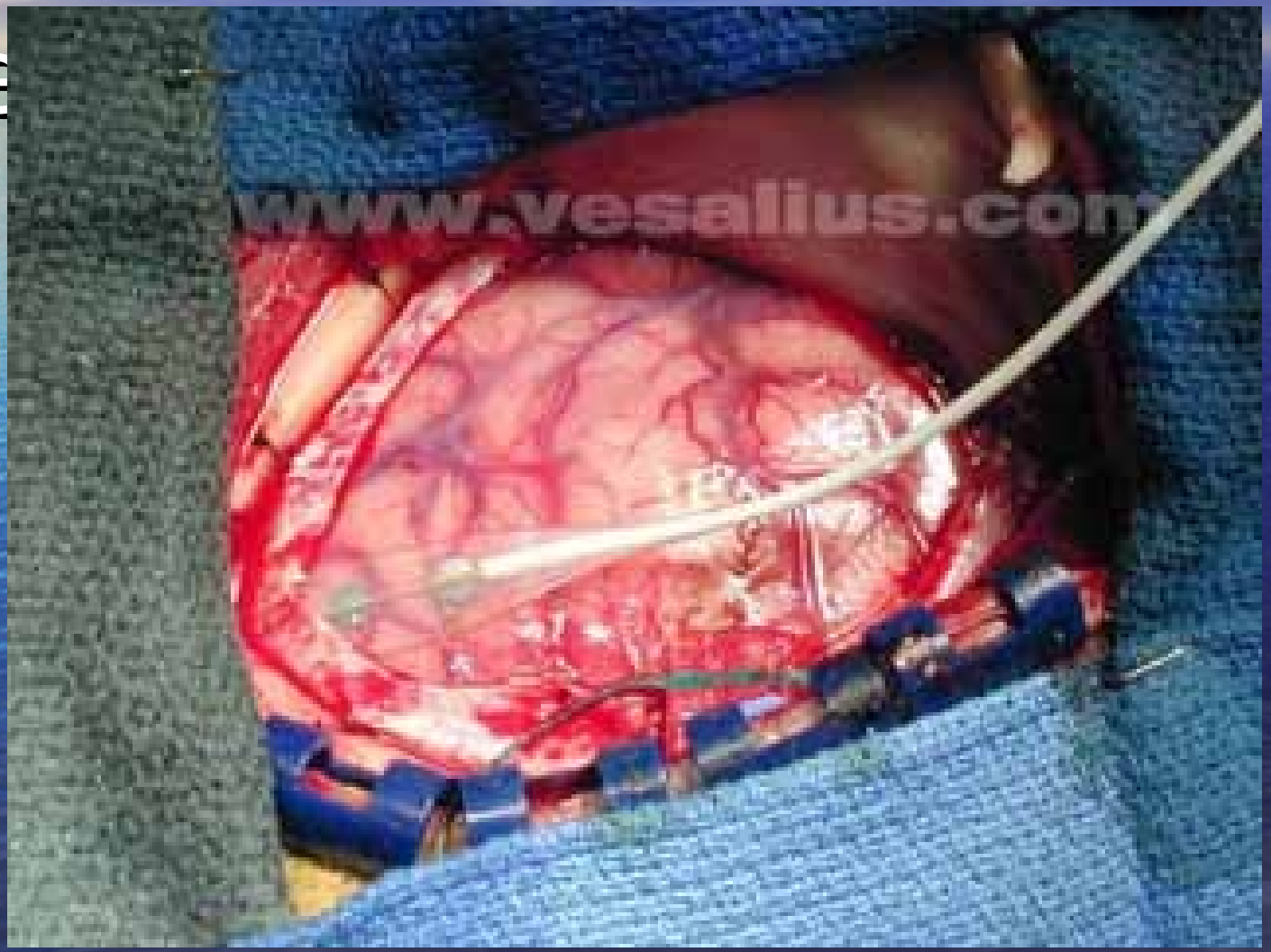
STEALTH Image Guidance



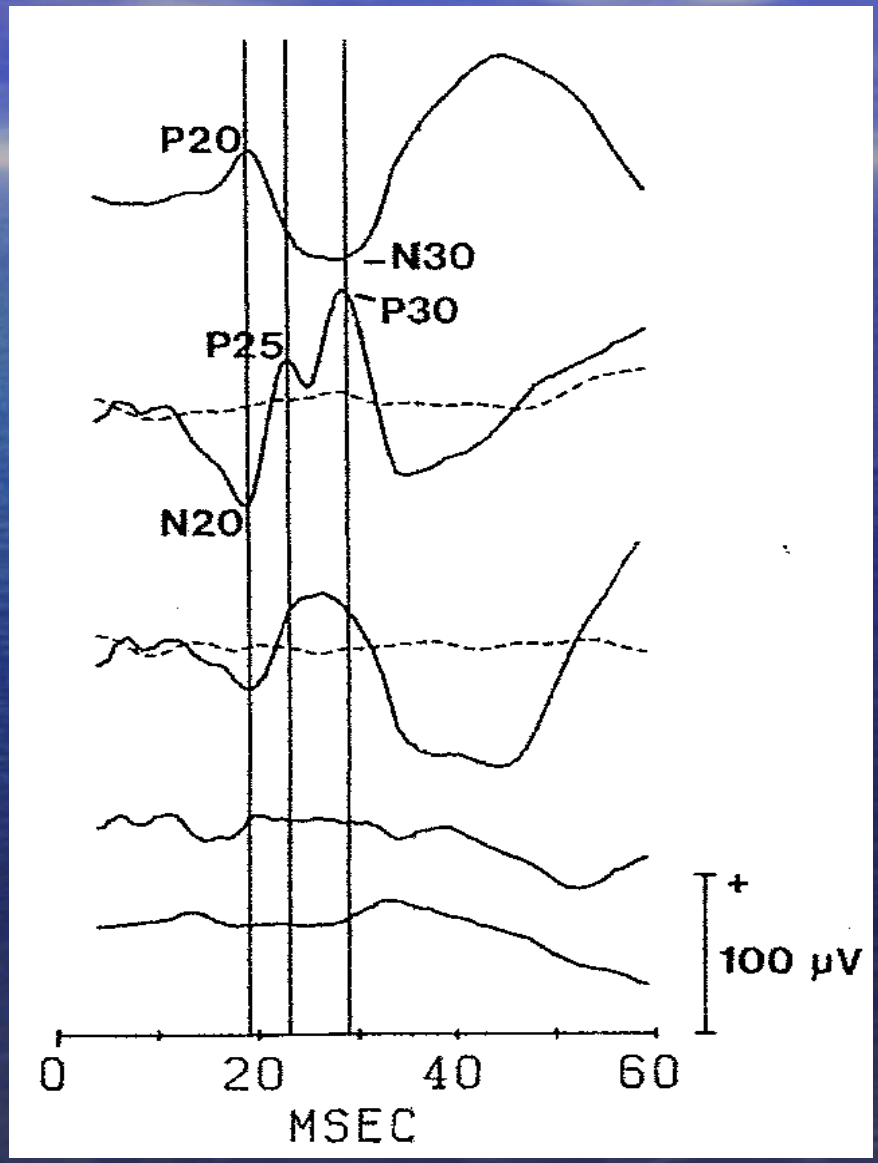
Electrocorticography

- Used primarily in epilepsy cases for tailoring of resection. Looks for interictal abnormalities
- Avoidance of benzodiazepems
- Propofol
  - Question of effect of EEG
  - Herrick, et. al. , 1997 to look at this issue

Strip Electrode for Identification of Phase Re



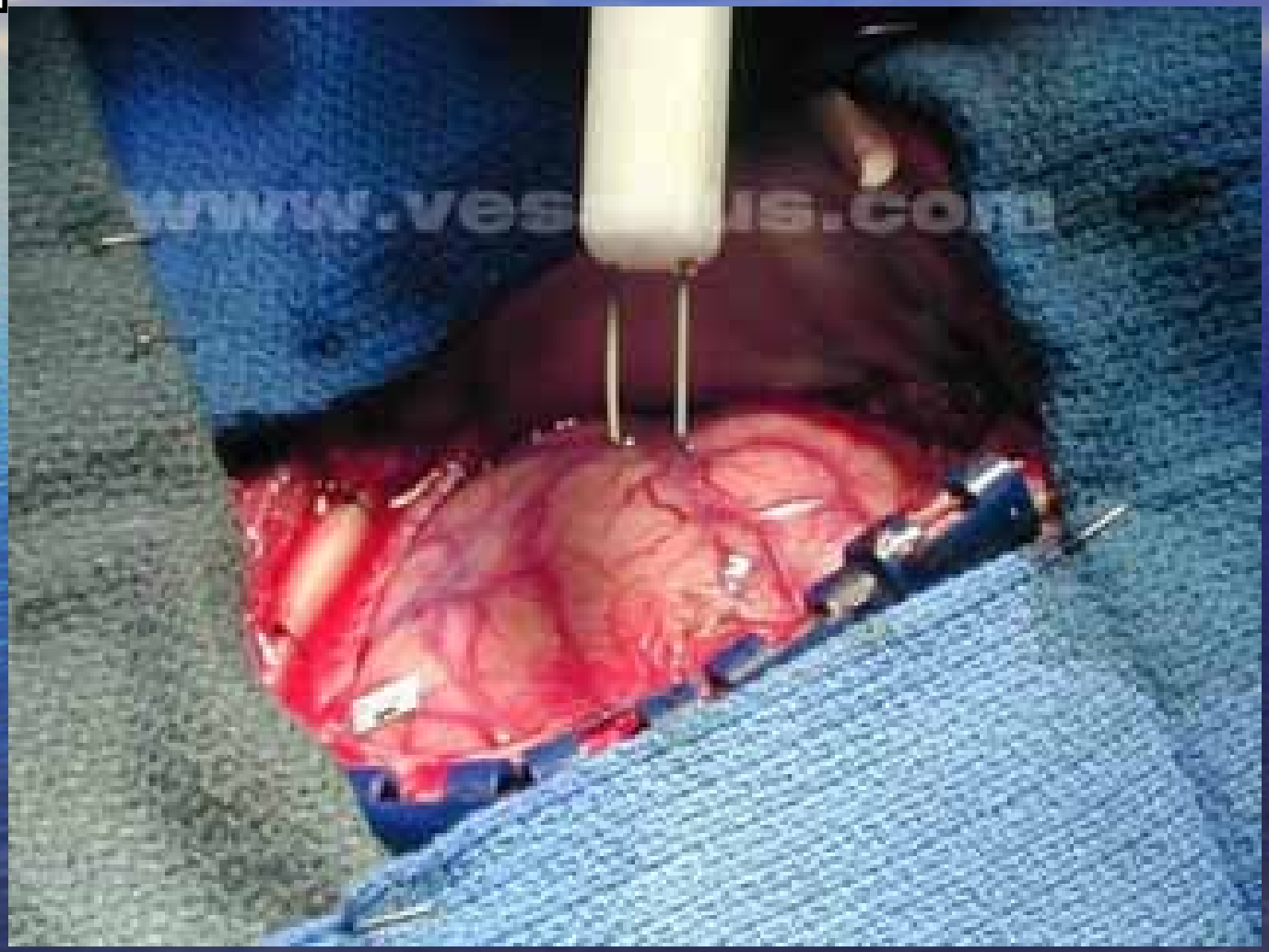
SSEP waves to Identify Phase Reversal



Stimulation

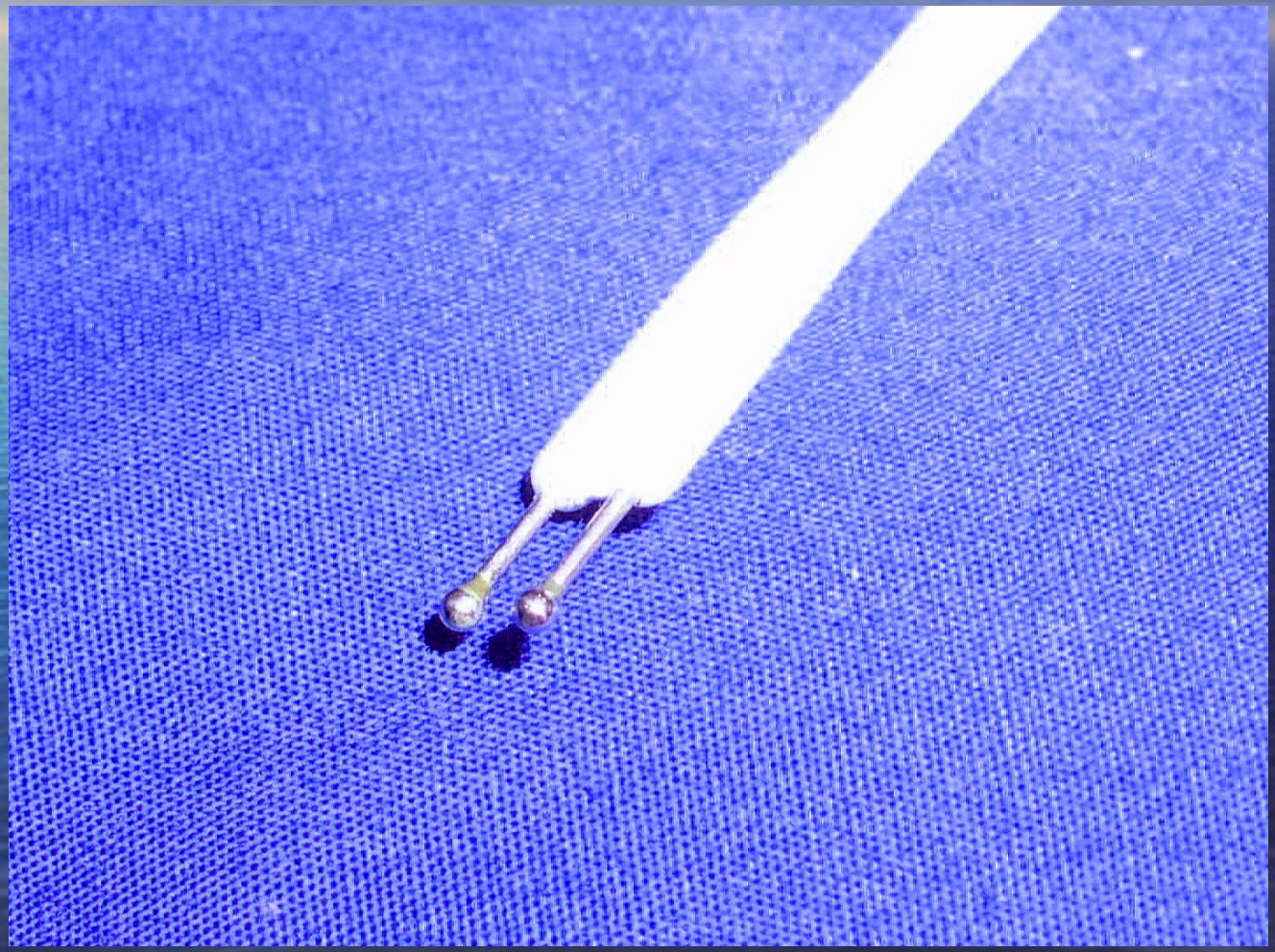
- Typically bipolar stimulation (Ojemann)
- Coordination with neuropsych questioning
  - Complexity of language testing
  - Look for arrest of speech or errors in speech
- Parameters
  - Start with low current, gradually escalate
  - Stimulated to effect or to after discharges
- Risks for inducing seizures
  - Some centers have methohexital or thiopental drawn up for rapid, short-lived intervention.

Stimulation with Ojemann Bipolar Stimulator



Ojemann Stimulator

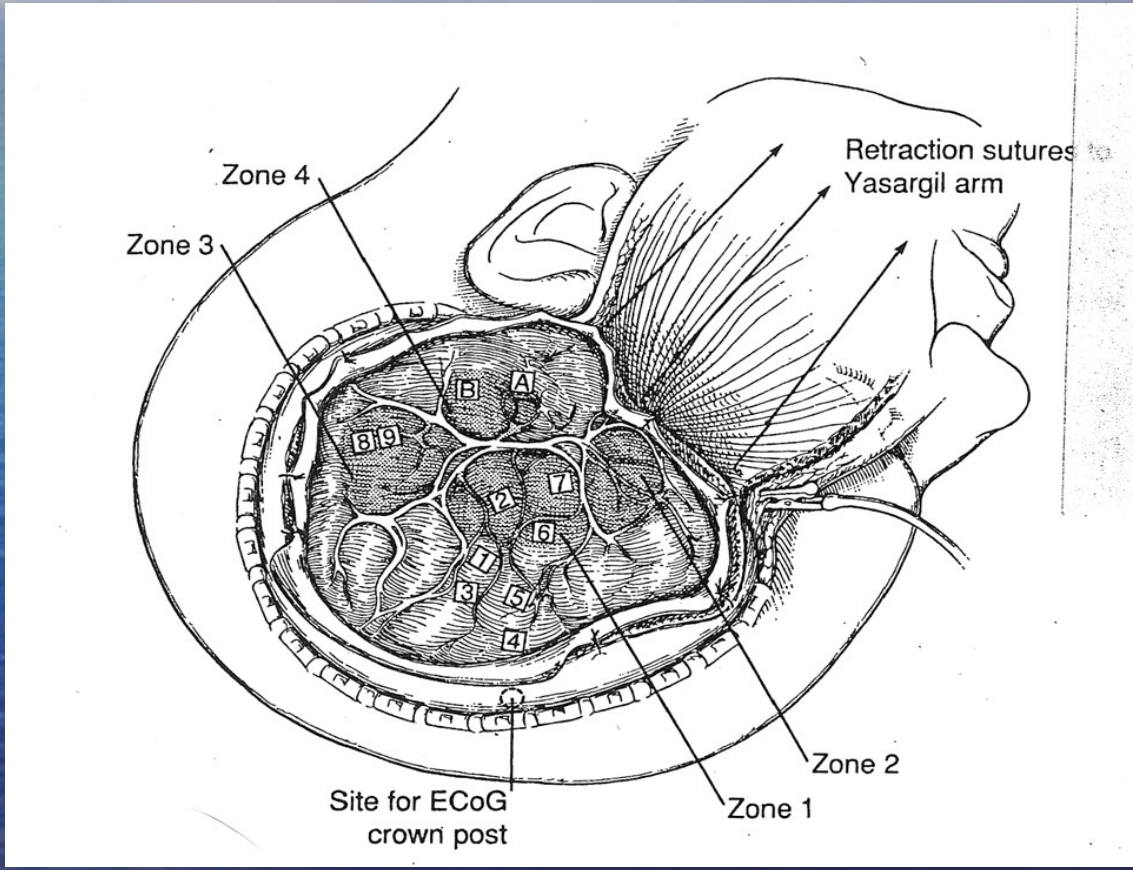
Handpiece of Bipolar stimulator



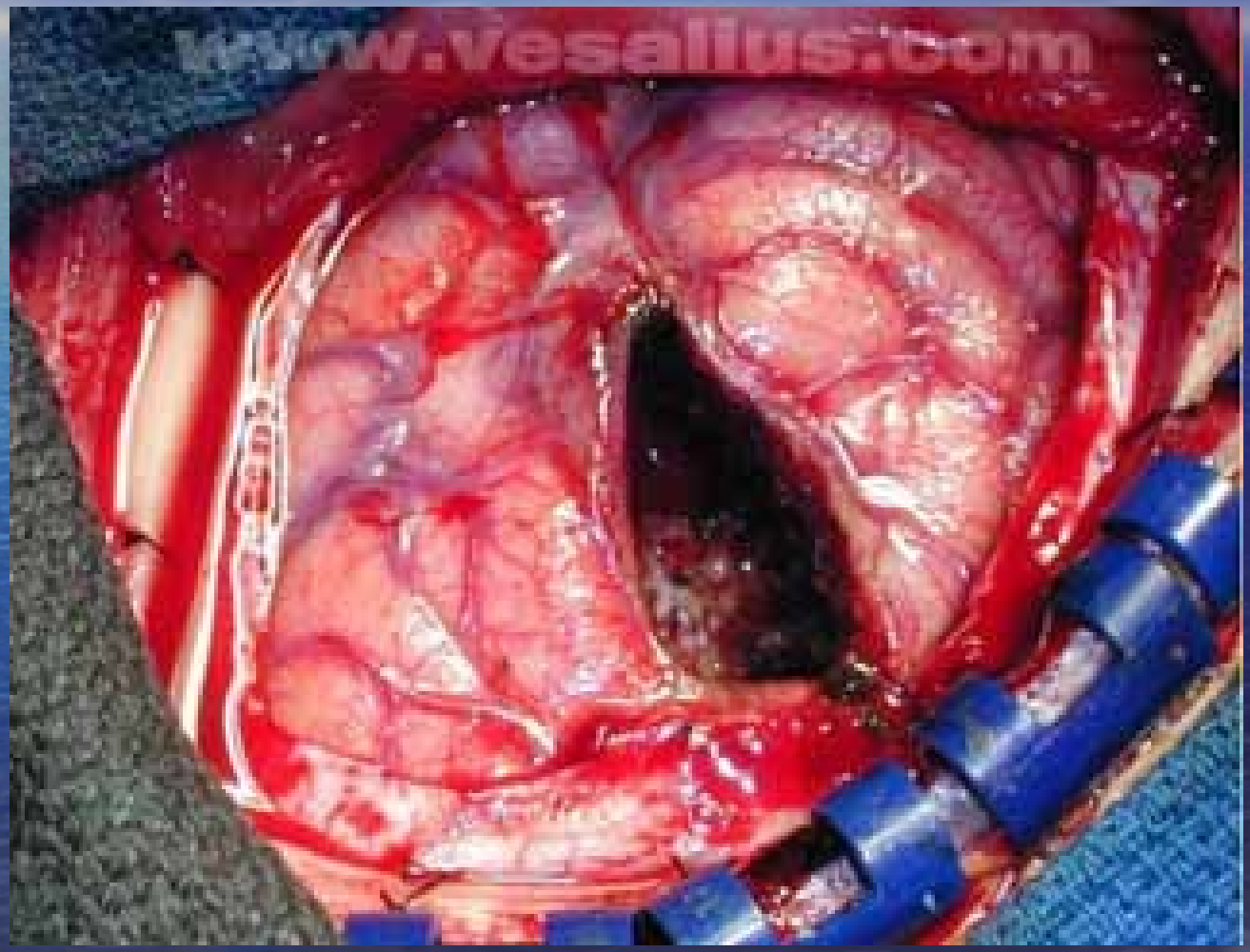
Language Tests

- Object naming
- Reciting stereotyped lists (i.e. months of the year, etc.)
- Comprehension (following simple commands, sentence completion)
- Generating new lists (i.e. 5 words that begin with the letter “B”

Example of Completed Map



Post-Resection Cavity



Anesthetic Techniques

- Propofol
- Neurolept anesthesia (fentanyl or alfentanil plus droperidol)
- Dexmedetomidate
- Patient controlled sedation (PCS) *Herrick, et al 1997*

Comparison of Medications

- Advantages to propofol: Rapid titration, reduced seizures, less nausea
- Disadvantages: May alter intra op EEG, more likelihood towards apneic incidents
- Often a combination of low dose background opiate with propofol works well

Propofol for ECoG

- Prospective study comparing usefulness of ECoG in groups receiving propofol vs. those receiving fentanyl plus droperidol
- Compared spike frequency, location of spike activity, spike propagation and background activity as well as intraop seizures

Herrick, et al, cont'd

- Blinded reviewer of ECoG
- Only statistically significant difference was increase in high frequency background activity in propofol group that did not affect the ability to use ECoG provided it was stopped 15 minutes in advance
- Significantly fewer intra op seizure with propofol

Sample Combination

- Schubert proposes the following regimen:
  - Propofol infusion 75-150 mcg/kg/min and
  - Fentanyl 0.5-1 mcg/kg/hr for induction
  - Boluses of 10-20 mg of propofol for a-line, foley cath placement
  - At the level of exposure to dura, reduces propofol and opioid and eventually stops propofol

Sample, cont’d

- Propofol needs to be stopped 15-30 minutes before ECoG
- Once resection complete, pt can be deepened for closure.

Dexmedetomidate

- Newer drug
- Used largely in ICU setting
- Case report for use in awake craniotomy at NYU.
  - Slower onset
  - Slower offset
  - Very little required (much less than for ICU sedation)
    - Dose for language mapping 0.1 mcg/kg/h
  - Has anesthetic sparing effect
  - Less respiratory suppression

Patient Controlled Sedation

- Reported to be done using basal rate of 0.5 mg/kg/hr with patient administered doses of 0.5 mg/kg with 3 min lockout.
- Anesthesiologist supplements with opioid and anti-emetic as needed
- *Herrick, et al* reported on such anesthesia with a very high degree of pt satisfaction

PCS, cont'd

- *Herrick et al* report average drug consumption for 5-6 hr case was 10.2 +/- 4 mg/kg propofol and 2.9 +/- 2.0 mcg/kg

- Herrick IA, et al. Propofol sedation during awake craniotomy for seizures: Patient controlled administration vs. Neurolept anesthesia. *Anesth Analg,* 1997; 84: 1285-91.

Complications

- Vomiting (8-10%)
- Respiratory depression
- Seizures
  - With neurolept anesthesia 16%
- Need to convert to general anesthetic
  - Approx 2-5%

Does it make a difference?

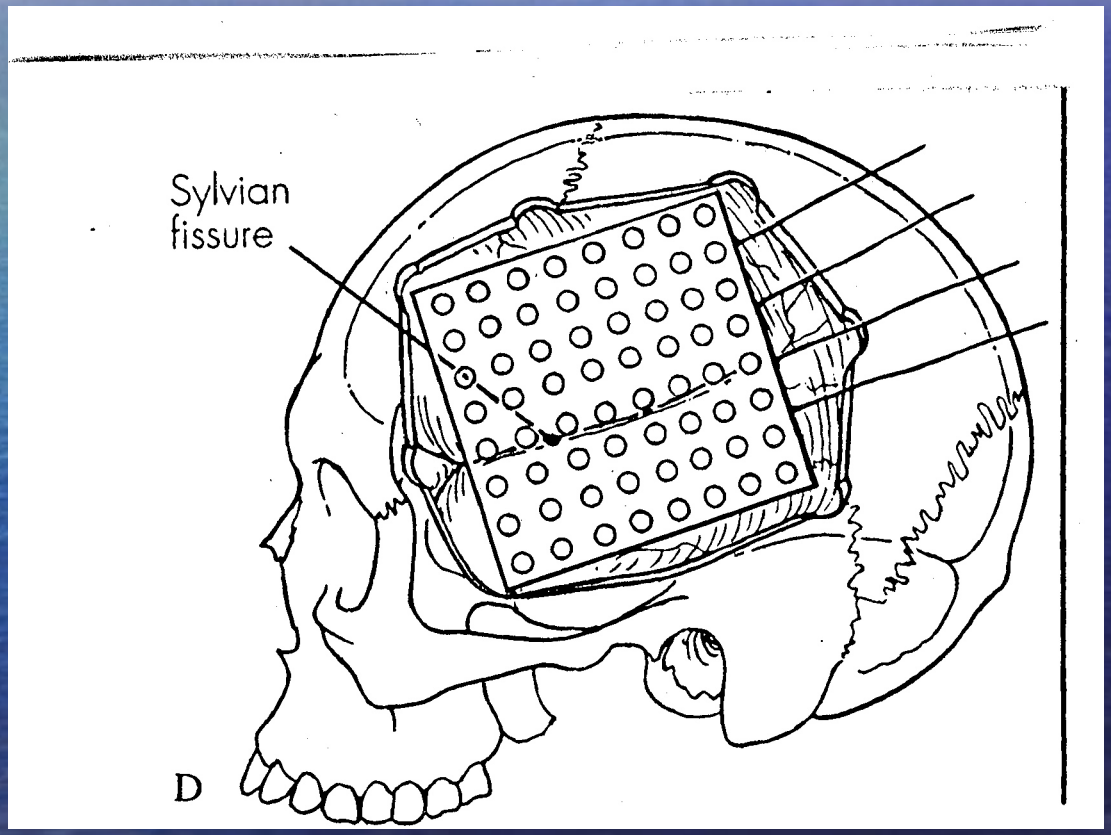
- Some data suggest that the median survival and disease free survival increase if one can achieve a >98% resection.
- Study biases: age, good performance scores
- May help adjuvant therapy
- Relieves mass effect
- Possibly decreased ICU and hospital stay

Taylor and Berstein , 1999

Alternative to Awake Craniotomy

- Subdural electrodes for extraoperative monitoring
- Good for children under the age of 10, patients not willing or capable of undergoing awake procedure

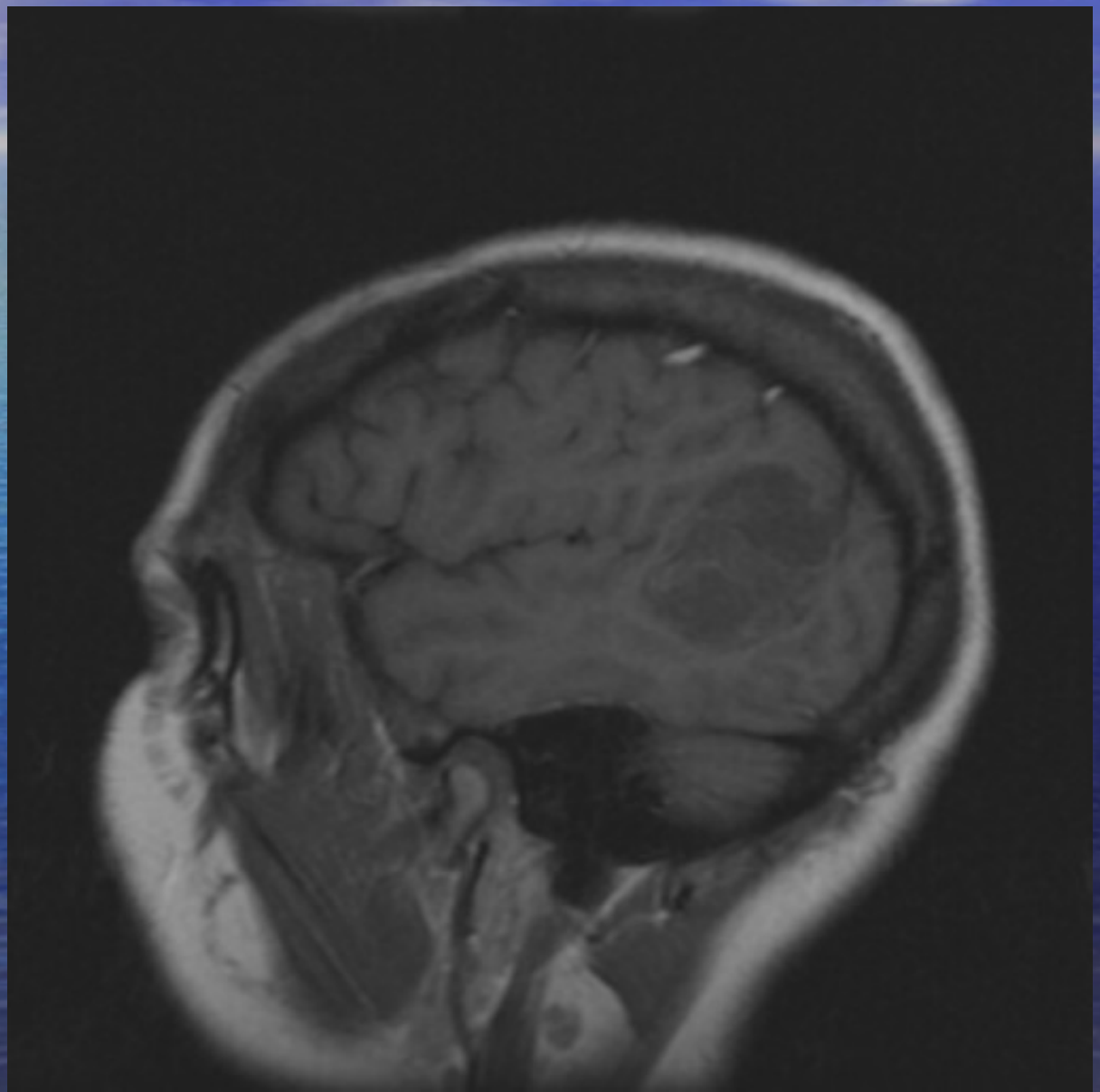
Subdural Grid Electrodes



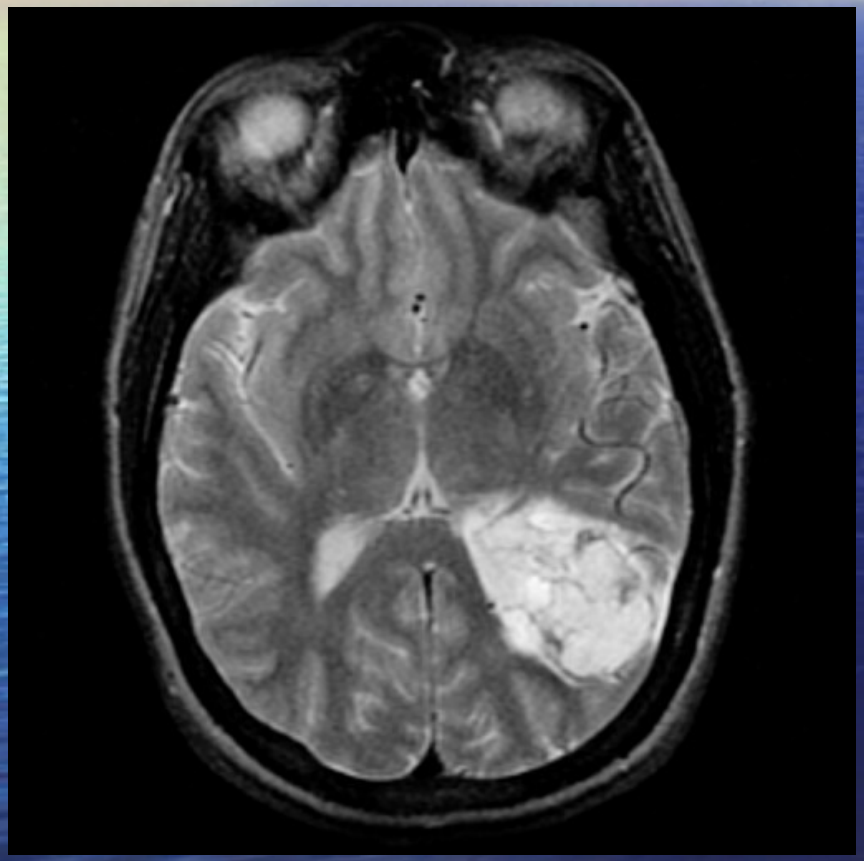
Case Study

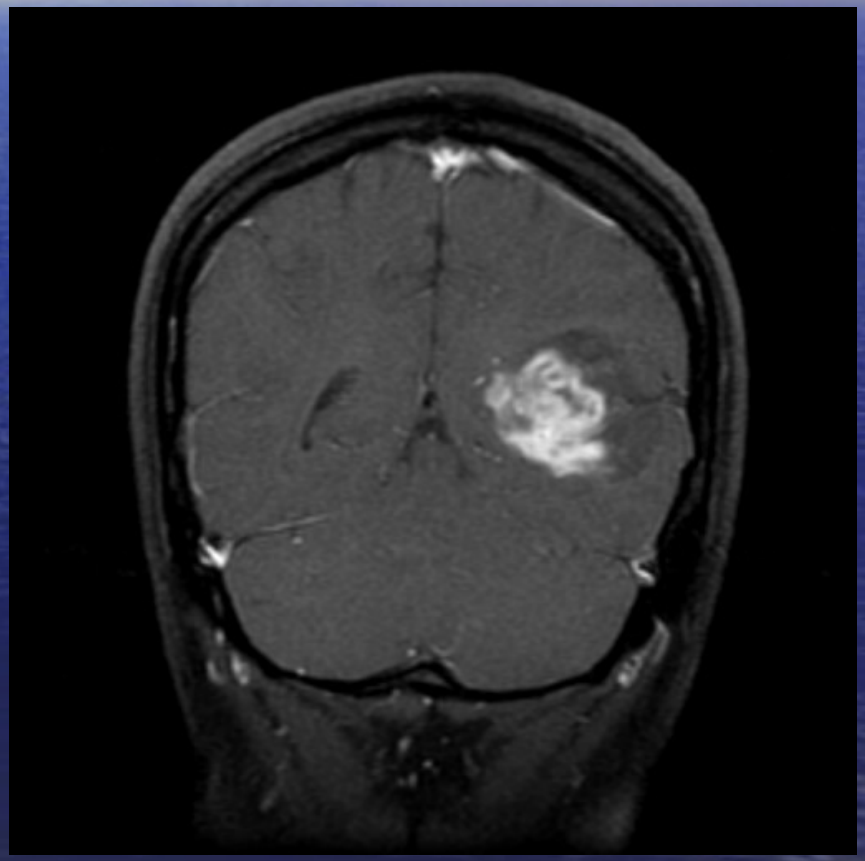
- L.C-M. 34 y/o RHD WF with seizure disorder for 10 years prior to presentation. Her initial frequency of complex partial seizures was 1 every 6 weeks, but increased to 2/wk. On close questioning, she reported that she did have some mild but progressive word finding difficulties. On imaging studies she was found to have large lesion in L posterior temp lobe. Serial imaging over two years showed a small but definite increase in size. VF showed a mild inferior quadrantopia on the R.
- Underwent STEALTH guided awake craniotomy for resection.Removed approximately 90% of the tumor. In immediate post op period had some exacerbation of word finding difficulty and a worsening of visual fields

L.C.-M. Preoperative sagittal MRI

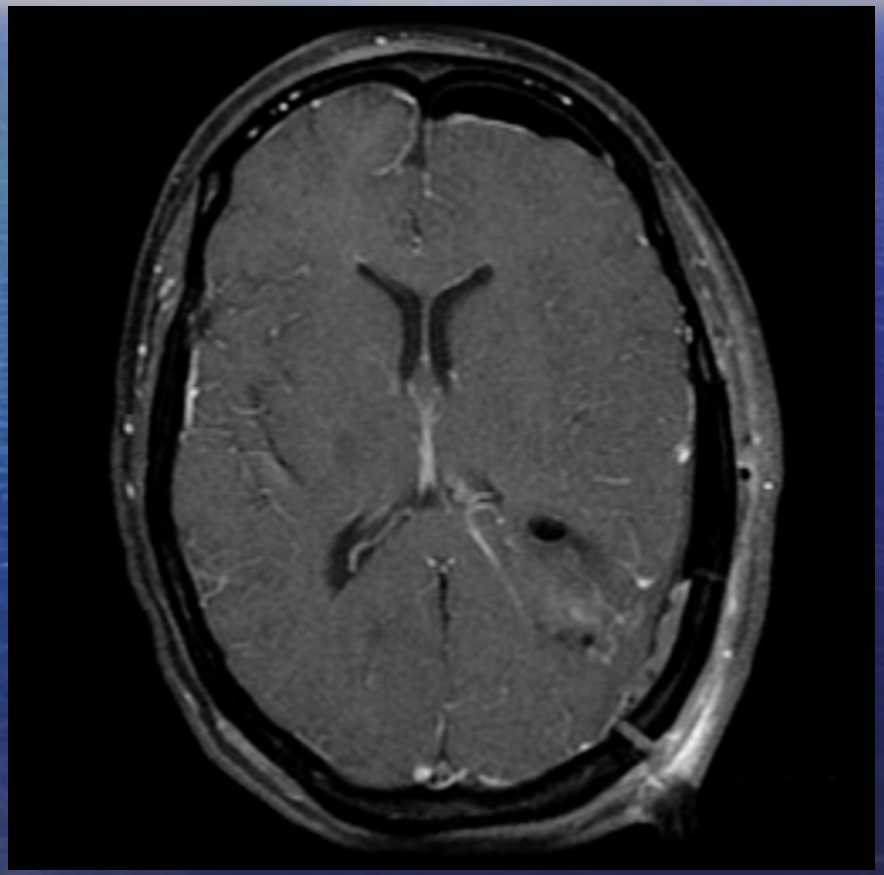


Preoperative T2 Axial and T1 coronal with contrast





Post operative T1 axial with gad



Case study cont’d

- At 1 month follow up, patient’s speech back to baseline and visual field improving
- Pathology mixed oligodendroglioma and pilocytic astrocytoma. Following with serial scans for regrowth.
- At 1 year, visual fields at baseline. Neuropsych data actually improved for language processing. Seizure free since 1 week after surgery.
- On full duty